Report of the
Computer-Human Interface Re-Evaluation
of the
Standard Terminal Automation Replacement System
Monitor and Control Workstation

Prepared by:
Standard Terminal Automation Replacement System
Human Factors Team

Submitted to:
Chief Scientific and Technical Advisor for Human Factors

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Executive Summary

This report provides the methodology and outcome of a follow-up evaluation of the computer-human interface (CHI) of the Standard Terminal Automation Replacement System (STARS) Monitor and Control Workstation (MCW). The original study was conducted in April 1997 and identified 89 human factors issues. The current test replicated the methodology used during that study to determine the effects of MCW software improvements. The evaluation was conducted in the STARS laboratory at the William J. Hughes Technical Center during the week of January 26, 1998.

Participants included human factors and Airway Facilities systems specialists and representatives from the STARS Program Office, Department of Defense, Professional Airways Systems Specialists Orgainzation, and the STARS Team (Raytheon and Hughes). The evaluation was completed during a 3-day period, using the same approach as the initial assessment.

Of the original 89 MCW CHI issues, 25 were closed for the Full Service Level (FSL) subsystem (with 20 remaining), 14 for the Emergency Service Level (ESL) subsystem (with 7 remaining), and 8 for both subsystems (with 15 remaining), for a total of 47 closed and 42 remaining issues. Several new items were developed as a result of the re-assessment. There were 3 new items identified for the FSL subsystem, 8 for the ESL subsystem, and 6 for both subsystems, for a total of 17 new MCW CHI items. As of this evaluation, there are 59 open MCW CHI items, which are detailed in the appendixes.

Although many improvements had been made in both systems, problems remained with color coding, error reporting, fonts, tabular displays, security, and consistency between the FSL and ESL subsystems. It is recommended that further work on the STARS MCW CHI be assigned to a team composed of human factors practitioners, AF systems specialists, PASS representatives, STARS contractor representatives, and STARS program office staff. This team should develop specific solutions to the CHI issues identified in this report.

1. Introduction

This report provides the methodology and outcome of a follow-up evaluation of the computer-human interface (CHI) of the Standard Terminal Automation Replacement System (STARS) Monitor and Control Workstation (MCW). At the request of the Terminal Systems Division (ARU-200), the Human Factors Branch (ACT-530) of the Federal Aviation Administration William J. Hughes Technical Center conducted an initial study of the MCW CHI (Mogford, Rosiles, Koros, & Held, in press). That investigation evaluated both the Full Service Level (FSL) and Emergency Service Level (ESL) subsystems of the MCW. The current test replicated the methodology used during that study to determine the outcome of MCW software improvements.

1.1 Background

The original investigation employed a CHI Review Team composed of engineering research psychologists and an Airway Facilities (AF) subject matter expert assembled from ACT-530 personnel. That investigation assessed the usability of the MCW in the context of the human factors information contained in the *STARS System/Subsystem Specification* (FAA, 1997) and criteria contained in the *Human Engineering Design Criteria for Military Systems, Equipment and Facilities* (DOD, 1989); the *Human Factors Design Guide for Acquisition of Commercial-Off-the-Shelf Subsystems, Non-Developmental Items, and Developmental Systems* (Wagner, Birt, Snyder, & Duncanson, 1996); and *American National Standard for Human Factors Engineering of Visual Display Terminal Workstations* (HFS, 1988).

CHI Review Team members conducted this evaluation in the STARS laboratory at the Technical Center during the week of April 7, 1997. They used a script of representative AF tasks to test each subsystem and also completed a side-by-side comparison. They analyzed the resulting data and presented it to ARU-200 on April 23, 1997 (Mogford et al., in press). The current test employed the same methodology and script to investigate the modified CHIs of the ESL and FSL subsystems.

Significant concerns from the initial evaluation of the FSL CHI included the number of user interface styles (i.e., graphical, command line, and character-based menu interfaces) and the use of status codes. Human factors concerns for the ESL subsystem included the range of user interface styles, cumbersome mouse actions, improper status coding, and limited access to subsystem information. The CHI of the ESL was entirely different from the FSL yet also required users to employ graphical, command line, and character-based menu interfaces. When compared side-by-side, the team noted that the FSL and ESL had independent and inconsistent interfaces. This lack of integration required the user to learn two CHIs, mouse interaction styles, and status-coding schemes.

The team concluded that the MCW represented a collection of unintegrated and independently formatted CHIs. They recommended that the MCW CHIs be internally and externally integrated into a single system. It was thought that this would help minimize human error and enable AF systems specialists to more easily navigate and access required system functions.

1.2 Scope and Limitations

The Human Factors Division (AAR-100) requested the current evaluation to assess the usability of the latest version of the MCW CHI design (including the FSL and ESL subsystems). Many changes had been made to the user interface since the initial evaluation, indicating that a review of the previous CHI issues was appropriate. The assessment focused on the ability of the user interface to support systems specialists' tasks. Data on the safety, efficiency, performance, and workload levels associated with this design were not collected.

2. Method

The CHI Review Team conducted a usability evaluation of the MCW in the STARS laboratory at the Technical Center. The evaluation replicated the methodology used during the initial study conducted in April 1997.

2.1 Participants

The current CHI Review Team consisted of human factors and AF systems specialists and representatives from the STARS Program Office, Department of Defense, Professional Airways Systems Specialists (PASS) organization, and the STARS Team (Raytheon and Hughes). The same approach used for the initial study was applied, and the original list of 89 usability items was revisited.

2.2 Materials

The human factors researchers prepared participant record forms designed to gather information on the previously identified 89 CHI items. Three SUN monitors were connected in the STARS laboratory so that evaluators could conveniently view the MCW CHI demonstration. The team used two video recorders to capture screen activity as each task in the test script was performed.

2.3 Script

During the evaluation, the team used a script of representative AF maintenance actions and tasks to perform activities on the FSL and ESL subsystems. The script employed for the initial evaluation was checked for completeness and revised as needed. The team executed the script on each subsystem and then compared the user interfaces of both subsystems.

2.4 Procedure

The human factors staff generally applied the same methodology employed during the first evaluation. The following subsections detail these procedures.

2.4.1 Usability Evaluation

The evaluation was conducted during the week of January 26, 1998. The AF systems specialist participants traveled on Monday and Friday. Tuesday was devoted to MCW training. Wednesday focused on the CHI evaluation of the FSL subsystem, whereas Thursday was

concerned with the ESL subsystem and side-by-side subsystem comparison. A wrap-up session was held on Thursday afternoon.

The CHI Review Team used data collection forms containing the 89 issues (45 FSL items, 21 ESL items, and 23 items relevant to both subsystems) that were identified during the initial evaluation. Each issue was revisited to determine its current status, and new issues were noted. CHI issues from the previous study were tied to script items or were labeled as general issues.

2.4.2 Data Collection and Analysis

During the evaluation period at the Technical Center, participants kept track of issues and their resolution. All comments were provided to the human factors staff in electronic form. Redundancies were removed, and a final list of issues was created. Issues identified during the previous evaluation were either classified as closed (C) or remaining (R), and new issues were listed. Additional lists of functionality and hardware items were also created. (These items were separated from the CHI lists if they appeared to address missing capabilities or other matters not clearly related to the CHI.) A final review of all items and their status was conducted with representatives from ARU-200 and PASS. The remaining and new issues were also analyzed with regard to appropriate human factors design standards and guidelines.

3. Results

Appendix A provides the list of the original 89 issues for the FSL, ESL, and both subsystems, comments resulting from the re-evaluation, and the status of each issue. (Issues coded as "C^{+}" refer to those that were closed because they were covered by another remaining or new issue.)

Of the original 89 issues, 25 were closed for the FSL subsystem, 14 for the ESL subsystem, and 8 for both subsystems, for a total of 47 closed issues. Items that remained from the previous list and new items are included in Appendix B, which should be used as the primary reference for further CHI work on the MCW. Also in Appendix B are new functionality and hardware issues. Appendix B contains 23 FSL issues, 15 ESL issues, and 21 issues for both subsystems.

In Appendix A, the issues relating to both subsystems remained in a separate table. In Appendix B, the items relating to both subsystems have been combined with the ESL items because the ESL issues will be the first to be addressed programmatically. The list for both subsystems has also been added to the FSL items so that they are addressed when the FSL is considered. Appendixes A and B reflect the combined comments of the AF specialists, human factors staff, and other participants who supported the re-evaluation.

4. Discussion

Although it was possible to close many of the original MCW human factors issues, there were remaining problems in the areas of color coding, error reporting, fonts, tabular displays, security, and consistency between the FSL and ESL subsystems. The following discussion is intended to provide a cursory overview of these issues but is not comprehensive or all inclusive. The reader should refer to Appendix B for specific details.

The number of status codes and colors has been reduced in the FSL subsystem, making the user interface simpler and easier to use. However, the existing color codes may not be consistent with the color assignments in existing AF equipment and may not be the same as some of those used in the ESL subsystem. Other codes, such as blinking, are used differently between the FSL and ESL. For example, in the FSL, a system failure is signaled by alternating red and green, whereas, in the ESL, alternating red and black signals a system failure. Many human factors guidelines recommend that redundant coding be used with color to overcome potential problems if colors are not visible due to operator color vision deficiencies, insufficient luminance, or glare. Redundant coding with color is not present in either subsystem.

The FSL exhibited problems in correctly displaying error information. For example, it was possible to fail some services and network components without a clear indication of the nature of the failure on the FSL screen. Also, some failures were incorrectly coded as catastrophic. FSL message handling should be improved so that catastrophic messages immediately appear in the message window at the top of the screen.

The ESL user interface has benefited from several improvements. There were, however, some human factors issues that still should be addressed. The ESL screen consists of three windows. This creates unnecessary window management overhead and could be resolved by consolidating the three windows with separate sections or panes. Some improvements in data display and interactivity are also needed. Although these and other changes to the ESL CHI would provide improvements, it should be modified only in the context of the integration of the FSL and ESL user interfaces. An overall CHI concept should first be developed that incorporates the FSL and ESL subsystems. Then, any changes made to the ESL interface can be made in this context and will only have to be addressed once.

Although the FSL has security and log on procedures, there is no log on required for the ESL. This provides insufficient protection against unauthorized access. However, the FSL may have too many security access levels. A review of security and log on procedures for each subsystem is warranted.

In the FSL and ESL, there were several examples of small font sizes, making reading difficult. For example, in the FSL, the selections under the menu commands are in a small font. In both subsystems, window titles are very small, and the font size and style in tabular lists are not the same. The background in tabular lists in the ESL is darker than the FSL, making the contrast a little better. It is recommended that both subsystems be reviewed for readable (and selectable) font sizes and optimal contrast between text and background in data displays and tabular lists.

In both subsystems, the requirement to employ UNIX commands has been greatly reduced, but some need for UNIX remains. This is acceptable with the assumption that AF systems specialists will be provided with appropriate Solaris training. There are several capabilities (e.g., backspace to erase in UNIX Console windows) that can be easily implemented using UNIX features and could be included in the system adaptation.

Auditory alarms were not available in either subsystem. It is essential to include such alarms to signal catastrophic failures or other critical system events. Human factors guidelines for auditory

alarms can be found in the *Human Factors Design Guide for Acquisition of Commercial-Off-the-Shelf Subsystems, Non-Developmental Items, and Developmental Systems* (HFDG) (Wagner et al., 1996).

As in the previous evaluation, there continues to be concern regarding the contrast in appearance and interaction styles between the FSL and ESL subsystems. Although efforts have evidently been made to create a more integrated look and feel, a significant number of differences still remain. Message displays, diagnostic functions, and other features lack consistency. The SUN VTS capability (which is present on both subsystems) now has a different user interface in each, whereas, during the last assessment, it was the same.

Human factors and operational evaluators commented that additional training requirements and workload would result from the need to operate two separate CHIs. Good human factors practice recommends that the user interface for the maintenance system be well integrated to reduce unnecessary cognitive demands on the operator.

Several approaches can be taken regarding CHI integration. There are some advantages to retaining the identities of the two subsystems. Using distinct user interfaces, it is easier to include a complex set of functionality for each subsystem and may help the operator remember which subsystem is being used. The individual CHIs for the FSL and ESL subsystems could be reformatted to make their appearance and functionality similar and compatible, and an interface manager could be added to simplify alternating between them. This interface manager could also display basic status information about the subsystem that is not in view.

However, a common or unified user interface has its own advantages. There is a possibility that all the display and control elements for both subsystems could be shown on one screen without undue clutter and complexity. A unified user interface for the FSL and ESL subsystems would obviate the need for the AF systems specialist to move between the two CHIs and be concerned about knowing the status of one while viewing the other. Appearance and functionality would be consistent. Users have suggested using a system block diagram method for a common user interface. This design philosophy would provide a high-level monitoring capability with system components clearly identified. If this approach was adopted, other components could eventually be included, moving toward an integrated CHI for all AF systems.

During the CHI evaluation, it became evident to participating AF systems specialists that several important functions were missing from the MCW (ESL and FSL). Included was the concern that system certification could not be properly completed, given current capabilities. Although the CHI evaluation was not intended to focus on system functionality, it was decided to include these issues in the report to draw attention to them. System functionality is indirectly a human factors concern because the system should support operator tasks. However, there are typically other mechanisms during system development, such as Operational Test and Evaluation (OT&E), that are designed to evaluate implementation of system functions with respect to requirements. There were also some equipment-related issues such as concerns about the maintenance accessibility of the SONY display. An ergonomic assessment of this and other hardware system elements may be needed.

5. Conclusions

In terms of STARS development, the first concern will be to focus on the ESL because it will be part of the Early Display Capability. As each issue is addressed, however, developers should address the CHI items concerning both subsystems. For example, changes in font size or color coding made to the ESL should be considered in the context of both subsystems. Consistency and compatibility should be maintained between the subsystems as decisions are made about the ESL CHI. It is recommended that an overall CHI integration philosophy be developed for the STARS MCW before making any changes to the ESL subsystem. In this way, when the ESL is addressed, it will adhere to this overall integration approach. This will avoid having to re-address the ESL during the next phase of MCW CHI activities.

The second phase of MCW CHI efforts will include the FSL subsystem. It is at this stage that CHI integration should be completed. The primary overall concern with the current user interface configuration for the STARS continues to be two disparate CHIs, each with its own graphical-user interface (GUI) and interaction style. Although progress has been made toward making them appear similar in terms of color codes and other features, many differences remain. Further efforts should be made not only to increase their similarity in appearance but also to make the interaction style uniform. This will reduce training requirements and the cognitive demands on the AF systems specialists, while minimizing operator errors.

In this report, it is not feasible to make specific recommendations for the best solutions for the CHI issues. Each item should be addressed by a team of human factors practitioners, AF systems specialists, PASS representatives, STARS team representatives, and STARS Program Office staff to ensure that CHI problems are brought to a timely and satisfactory resolution. Rapid prototyping and other development tools should be used to visualize and evaluate CHI options before implementation. A further CHI assessment is not necessarily warranted as long as the issues identified in this evaluation are closed satisfactorily. This should be accomplished with the agreement of those representing human factors, user, contractor, and program office interests. However, final testing of the MCW should be incorporated into the OT&E of the STARS. At that stage, the safety, efficiency, performance, and workload levels associated with this resulting design should be evaluated.

Several of the participating AF systems specialists addressed ergonomic issues associated with physical movement of the Terminal Controller Workstation (TCW) main display. If an ergonomic evaluation is not included in other system development activities, it should be completed prior to OT&E.

6. Recommendations

The following activities should occur as part of the MCW CHI effort (estimated start and completion times will be finalized at a later date):

1. Resolve MCW ESL CHI issues by forming a group composed of human factors practitioners, AF systems specialists, PASS representatives, STARS team representatives, and STARS Program Office staff. Develop an overall MCW CHI integration strategy and address the ESL in the context of the selected approach.

2. Resolve MCW FSL and CHI integration issues by continuing the work of the group of human factors practitioners, AF systems specialists, PASS representatives, STARS team representatives, and STARS Program Office staff.

3. Establish a satisfactory procedure for closing MCW CHI issues. Conduct a final usability assessment and validation study, if needed.

4. If necessary, complete an ergonomic evaluation of STARS hardware components.

5. Conduct a final evaluation of the STARS MCW CHI during system OT&E.

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Acronyms

AF	Airway Facilities
ATIS	Automatic Terminal Information Service
CDR	Continuous Data Recording
CGW	Communications GateWay
CHI	Computer-Human Interface
ESL	Emergency Service Level
FSL	Full Service Level
GUI	Graphical-User Interface
HFDG	Human Factors Design Guide
LAN	Local Area Network
MCW	Monitor and Control Workstation
MSAW	Minimum Safe Altitude Warning
OCP	Operational Computer Program
OT&E	Operational Test and Evaluation
PASS	Professional Airways Systems Specialists
RDP	Radar Data Processor
SPC	Special Purpose Code
STARS	Standard Terminal Automation Replacement System
TCW	Terminal Controller Workstation
VSP	Variable Site Parameter

Appendix A

Original MCW CHI Issues

Table 1. Status of Original FSL Subsystem MCW CHI Issues

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
1	There are at least 17 different codes (consisting of combinations of color, blinking, and location) used on the main page of the FSL subsystem. There are 12 colors used. (Page 18 of manual.) There are also at least three further color codes for lettering in windows. There are also two window boundary color codes to indicate if the user has control over the window. There is color coding in data entry fields to indicate whether entry is allowed, not allowed, or incorrect. Some of the color contrast (letters on buttons) may not be sufficient (e.g., yellow on green for TCW failure). This is too many codes for the operator to learn and use and could lead to confusion and errors.	The coding of the FSL subsystem is greatly improved. However, a review of the color assignments is needed to ensure that they conform to colors used in other AF systems. Redundant coding is needed. Other issues include: • Some failures may be color coded incorrectly as catastrophic. • The iconified main window should only flash when there are unacknowledged high priority or catastrophic messages. • Lower level failures are not necessarily propagated to the higher level display. • Acknowledging faults returns items to light green (indicating normal operating status) even though the system may be operating in degraded mode. • The indication of which tape is being used for CDR and which are in standby is not clear or consistent with the other color schemes. • In the diagnostic reports, failed tests should be color coded to indicate a failed status. Colors should be consistent with system color coding schemes. • The color coding scheme should follow the failure for all applicable views. • There are several different configurations (available, available/testing, available/playback, off-line, off-line/testing, and maintenance) that should be reviewed and simplified.	R
2	There are three types of user interfaces in the FSL subsystem: a point-and-click, pull-down menu, and button interface; a simpler key-controlled interface; and a UNIX command window. This requires the user to learn too many interaction styles and is not consistent. The UNIX windows in particular require very complex command syntax. Example: To launch diagnostic tests, users must enter several commands using UNIX command language, which requires extensive training (1472D, Table XXVIII). Once the diagnostic program is launched, the user must switch from using UNIX command language and begin using tabs and the space bar to navigate menus.	There is a reduced reliance on the UNIX interface. The system should have a GUI-type of CHI for the SUN VTS diagnostics instead of the keyboard-controlled interface. (Addressed in Table 3, Item 3.)	R
3	The settings for the audible alarm range from 0 to 255. The units are arbitrary. The alarm volume can be turned to zero volume, which means the user may not be notified of an emergency.	Auditory alarms are not available. Auditory alarms are needed.	R

* C = Closed; R = Remaining; C^+ = The original item is closed, but a more general issue remains to be addressed.

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
4	There is no indication of processing status. For example, several minutes may be required for some diagnostic routines. There is no indication of how much time has elapsed. There may also be no indication that the system is in a diagnostic mode. When analysis is being conducted, there is no feedback to notify the user that analysis has been completed.	In the SUN VTS window, there is an elapsed time indicator that updates every 5 seconds. There is no indication that diagnostics have commenced for a few seconds. This could suggest to the user that nothing is occurring. A "testing completed" message appears when the tests are finished. In general, there should be 1) an indication that the system is in test mode, 2) an indication that the test is progressing, and 3) an indication of how much time is remaining.	R
5	In the UNIX console window, it may be possible to execute destructive commands, such as a disk format. Errors in command entries could involve loss of data or system function.	There is password and user-level protection against unauthorized access to a level of UNIX where destructive commands can be executed.	C
6	Some text display windows have white lettering on a gray background. There may not be sufficient contrast for reading.	Although poor contrast was not observed to impact readability, the contrast of text to background should be evaluated and optimized. (Addressed in Table 3, Item 18.)	C^+
7	Alarm message acknowledgment is awkward. Messages can be acknowledged all at once, page-by-page from the Messages window, or one at a time in message box (main display). When the user acknowledges all alarms, it could result in confusion over which message produced the alarm. The user must open the messages list and read through the messages to determine which is responsible. This list does not aid the user in identifying the source of the alarm. From the main monitoring window, users can only view one message at a time. This message must be acknowledged in order to move to the next message. Users may be forced to acknowledge several less important alarms (without being able to take action) in order to reach a critical alarm. It is likely that important information could be inadvertently lost.	Catastrophic messages should appear at the top of the list, in the message window at the top of the screen. Color coding of alphanumeric messages should be considered. Column headers for alarm messages should also be considered. Error message text should be clear, unambiguous, and consistent with the ESL system. In general, alarm message display and handling should be evaluated and revised.	R
8	There is no on-line help system available.	On-line help is not available. AF systems specialists should be asked to identify what information should be provided on-line.	R
9	The color of Radar Link button did not change to red even though there was a critical failure. Removing a single FSL subsystem LAN connection was not detected by the MCW. Removing both FSL subsystem LAN connections changed the color of the icon to flashing red and light green. Thus, it is possible to lose critical resources without an indication on the MCW.	There are problems with the alarm indicators when there is a system failure. For example, when LAN A was disabled, the system showed a failure of both LAN A and B. Also, the CGW A icon goes gray, but there are too many incorrect alerts for this one LAN failure. System error detection requires more analysis.	R
10	Audible alarms do not discriminate between alarm conditions. The same auditory alarm is used for all types of alarms and for other informational messages.	Auditory alarms are not available. Auditory alarms are needed.	R
11	Some actions do not provide feedback when the user reconfigures a screen.	This is partially complete. A confirmation is needed for MSAW. The CHI should be re-evaluated to determine whether sufficient error feedback is provided in all cases.	R

* C = Closed; R = Remaining; C^+ = The original item is closed, but a more general issue remains to be addressed.

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
12	When in a UNIX console window, it is not possible to erase an entry by backspacing over it. This would make it difficult for the user to correct command entries.	Backspacing can be enabled by typing a UNIX command. This should be added to the adaptation file so that it is always available to users. (Addressed in Appendix B, Table 1, Item 43.)	C^+
13	Labels on working positions change based on assigned airspace (for example, DR/D6 instead of TCW 1). This requires MCW operators to perform mental operations to identify workstations, and may be particularly bothersome when switching from the FSL to the ESL subsystem. (The ESL system always uses a TCW number.)	Workstation labels no longer change as airspace is assigned or re-assigned. AF systems specialists are able to access airspace assignments quickly when needed.	C
14	The lines below the Radar Link buttons (in Radar Link window), which indicate status of incoming radar links, are not labeled. When viewing the status of a radar link, the meaning of the two vertical lines is not apparent.	Labels have been added, but it is recommended that labels and color coding be evaluated in more detail. The Radar Link window is small but has a large, colored button. This button may not give much information via its color coding. The legs are not visible when colored gray. The Radar Link window formatting and functionality should be reviewed.	R
15	The Cancel function does not perform the same in all windows. On some windows, it closes the window, but for others it clears the values in the window with the current focus. Also, the Cancel function is only available in some Modification windows and not others.	Cancel has been changed to Yes/No or OK/Exit, as appropriate.	C
16	The area showing the number of unacknowledged messages at the top of the main window shows red flashing with an audible alert if a catastrophic message has been received. It shows gray for other error messages. This coding may not be a clear representation of the status or presence of error messages that are not catastrophic failures.	The Count button becomes yellow if an unacknowledged high priority message is present. Alarm message and handling should be reviewed. (Addressed in Item 7.)	C^+
17	In the Tile Modification window, the user tried to modify a value before disabling MSAW. The data entry field turned red, but there was no information as to the nature of the error.	A format message is now provided for all incorrect data entries, but an explanation is not included. The CHI should be reviewed for the need for other error feedback messages. (Addressed in Item 11.)	C^+
18	When entering data in fields, there are no guidelines for format. For example, when entering date and time, there is no indication whether colons or slashes are needed. There is also no indication in other entry fields regarding limitations on the size of the entry, such as for log in. This may lead to unnecessary confusion and errors.	There are indicators for each data entry field specifying format. There should be consistent data entry fields for the FSL and ESL subsystems. (Addressed in Table 3, Item 16.)	C^+

* C = Closed; R = Remaining; C^+ = The original item is closed, but a more general issue remains to be addressed.

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
19	To place a TCW in the test state, assigned airspace must be moved to another station; the TCW must be placed in off-line maintenance mode; and a UNIX window opened and the testing software launched. This procedure involves multiple steps and does not provide guidance. For example, if the user attempts to take the TCW off-line before reassigning airspace, the Off-Line Maintenance option is dimmed, but no indication is provided as to how to remove the workstation for maintenance.	It is no longer necessary to open a UNIX window to take a TCW off-line. Some FSL functions require multiple steps, for example, bringing TCWs and radar links on-line. To bring a TCW from maintenance to on-line, it must first be taken off-line. It would be preferable to go directly from maintenance to on-line or from on-line to maintenance. In general, there should be three system states (i.e., on-line, standby, and off-line). To bring radar links on-line, the user must bring the radar link on-line, select VSP and, then, enable three separate weather items. There is no indication that these must be enabled. The user must go to a long list to find the items to be enabled, and the process requires multiple steps.	R
20	Abbreviations such as POS are used in several windows, response messages, and tabular displays. This requires the user to remember abbreviations. There often appears to be room for full spelling out of the label.	The number of abbreviations has been greatly reduced.	C
21	When you resize a window, data is not resized, most of the data is cropped. Maximization of diagnostic window did not provide for an increase in font size.	In the present version, only the SUN VTS window (diagnostics) is resizable. A review should be made of all windows in the FSL subsystem to identify window resizing requirements. (Addressed in Table 3, Item 11.)	C^+
22	System VSP Control contains a long scrolling list that appears to include functions not required by an MCW operator.	The system VSP Control window contains functions that may not be required by an MCW operator and should be reviewed (e.g., functions such as Flight Plan Miscellaneous Parameters and ATIS code may not be needed).	R
23	The method for modifying parameter values is inconsistent. Some functions have a separate window for making modifications and others do the modification inside the active window.	The method to modify parameter values is now consistent. (Addressed in Table 3, Item 7.)	C^+
24	Users have to do too many actions to complete an activity. Once a modification is made and a change is accepted, the user must still click an Exit button to get out of the window.	Multiple actions are required in some cases, but this did not appear to be a problem (except as noted elsewhere). Useful information is provided when the window remains open. (Addressed in Table 3, Item 7.)	C^+
25	SUN VTS software is in separate directories (UNIX level). Releases can be seen by UNIX command.	It is no longer necessary to activate a UNIX window.	C
26	Window Titles • Windows have two titles. One on the top border, and one inside the window. • Some windows have two titles which are not the same. • Not all window titles are in Title Case. Some words in a title start with lower case letters.	Different titles are acceptable, but the font size for title bars in windows should be larger. Titles should be reviewed for their relationship to the window contents.	R
27	There is no way to distinguish between manual data entry boxes and those with a drop-down menu. The pop-up menu and manual entry provide no indication which type of entry is required. Without distinguishing features, the operator may not be able to tell which type of data entry is permitted, leading to unnecessary actions and errors.	There are some data entry fields that have pop-up menus with no indication of this capability.	R

* C = Closed; R = Remaining; C^+ = The original item is closed, but a more general issue remains to be addressed.

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
28	Response message areas are sometimes unnecessarily large. Response messages are sometimes in mixed case, sometimes upper case. This could be understood to indicate different types of messages.	The response message area remains large, but this is not a problem. Response message case is used inconsistently and should be standardized to mixed case.	R
29	The system beeps when a out-of-range value is entered (sometimes). Sometimes, when an ineligible entry was given (e.g., c when only a or b were options) the system would beep after Modify was clicked or the Enter key was pressed. There appeared to be some inconsistency to the range checking /feedback process.	When characters are entered beyond the space available in the box, beeping occurs with every key press. If an out-of-range value is entered, the entry field becomes red after OK is clicked. The entry location should only have enough room for the maximum characters being entered. Consider keying text entry fields to data entry format, for example - - / - - / - - (for day, month, and year).	R
30	After changing a setting in the system, a warning window often appears stating "Configuration will change!" This is not very informative and does not request a confirmation of the previous entry.	The confirmation messages ask whether the user wants to proceed with the change. A Yes/No response is required.	C
31	Mouse click response time is slow. There is a delay of acceptance when the mouse is clicked on the Exit button in a window. If the mouse is moved out of the window too fast, the action is not accepted.	No problems with system response time were noted during low-load conditions.	C
32	In the Tile Modification window, there are two initial selectable options. If the wrong one is chosen, the user must close and reopen the window in order to make a new selection. This adds unnecessary steps to the interaction.	Tile Modification is not an AF systems specialist function and has been removed.	C
33	Unnecessary information is displayed. For example, the XY coordinates of windows are shown as they are moved.	XY coordinates are displayed but are not a problem.	C
34	In VSP and other similar windows, a list of accessible control items is shown. Selecting one of these brings up another window where only one value can be changed. This creates unnecessary interactions.	The interface for System VSP is acceptable for the FSL subsystem. (Addressed in Table 3, Item 7.)	C^+
35	It may be possible for a specialist to log in at a supervisory level and be vulnerable to having someone else log in at a lower level, thus revoking the earlier log-in. This might prove confusing if several people are using the system concurrently. Some commands seem to be available even though they cannot be accessed at the current log-in level. This might lead to confusion regarding system operation.	Passwords are required and provide access only to approved functionality. Too many levels of system authorization are used, therefore, consider using fewer levels. Access to MSAW tiles should be evaluated.	R
36	UNIX commands are required to log in to remote TCWs. The alias that is available to terminate remote processing (cds/killall) is nonfunctional. Super-user rights are needed to terminate and restart the processes in the remote TCW.	The requirement to use UNIX has been reduced. (Addressed in Table 3, Item 1.)	C^+
37	One of the main commands, Authorization, has no sub-menus and is not consistent with the others.	Authorization is not consistent with other main commands. Consider moving authorization into an Access Levels pull down menu to simplify the interaction. Consider moving the Print command under another menu option.	R

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Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
38	Tabular data displays: • Tables do not have consistent text justification. Some columns are left-justified, some are right-justified, and some are centered (e.g., RTQC Registration Control Report window). • Some columns are not evenly spaced (e.g., System VSP Control window). • Some column headings are crowded together, such as 1/512NM.	Tabular lists are inconsistently formatted and should be reviewed.	R
39	System Messages (located at the top of the monitoring screen) are not labeled.	A label is not necessary.	C
40	Labeling: • Missing labels. Some groups and items are missing labels. For example, the data recorders and LAN lines. • Label location. Labels are not located in a consistent manner. • Not all labels are unique. The primary and redundant RDAs (A or B) and Local MCW (1 or 2) systems are identically labeled and the user must look to the button to determine which system it represents.	Labeling is improved, however, consider changing CDR A/B to CDR 1/2 and, likewise, with RDP and CGW.	R
41	Data entry fields behave differently but appear the same. Some fields accept manual text entry, whereas others only accept preselected entries from a pop-up menu.	There are some data entry fields that have pop-up menus with no indication of this capability. (Addressed in Item 27.)	C^+
42	The flash rate of blink coding is not adaptable.	The flash rate does not need to be adaptable.	C
43	The brightness coding of displayed objects is not adaptable.	Brightness coding does not need to be adaptable.	C
44	When running diagnostics, button color remains the same.	The button color turns gray to indicate maintenance mode, but there is no indication that the subsystem is in diagnostics mode. (Addressed in Item 1.)	C^+
45	Window labels are color coded but not consistently. White labels are used for fields that allow text entry. Blue labels are used for fields which have information filled automatically by the system. However, sometimes blue labeled fields are editable (e.g., Tile Modification).	This has been corrected. White fields can be edited, and gray ones cannot.	C

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Table 2. Status of Original ESL MCW CHI Issues

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
1	It is difficult for the operator to determine status details from the main display. Though radar failed, there was no indication at the top-level-monitoring screen since radar was coming from a second site (the workstation icon remained green). A user would have to drill down to system status to find out that data from one radar was missing. Furthermore, Radar Link status is not monitored.	For the resources that are being monitored, error display is adequate. All failures are now indicated on the main display through the use of color and flashing. However, not all ESL subsystem resources are being monitored.	R
2	No audible alarms are used in the ESL subsystem. If a user is distracted from the display, there is no cue to call attention back to the screen.	The ESL subsystem does not provide audible alarms. It should have alarms for critical events and they should differ from other audible alarms.	R
3	It is possible to shut down the ESL software completely. This might be a problem if the operator inadvertently shuts down the system while in an emergency situation.	Safeguards are now in place to protect against an inadvertent shut down of the ESL subsystem.	C
4	The system uses inconsistent user interface input methods. The ESL subsystem provides GUI, character-based menu, and UNIX interfaces. Main ESL subsystem controls are dispersed among three windows (control menu, TV monitor [i.e., notifications], and consoles).	Virtually all functions are performed via a GUI. The requirement for the use of UNIX has been reduced. Window management is cumbersome. The ESL subsystem consists of three unintegrated windows. This requires the user to take more actions to open, close, and manage (resize and locate) each of the windows.	R
5	The user can change display color coding and could change emergency color codes. This could lead to errors if other operators use the system.	Color codes are adaptable, but not by the user.	C
6	Compromised systems are represented by changes in color and icon. However, the meaning of the colors is unclear, and software and hardware failures resulted in presentation of the same icon. When a workstation, represented in blue, was shut down, the monitoring screen did not indicate the loss of the workstation. (When repeated for a working [green] workstation the icon did change to red.) Warning status shows inconsistent information at the next level. (Sometimes, only red and green status appear and sometimes red and yellow status are displayed.)	Color coding is easily interpreted. However, redundant coding has been eliminated and should be reconsidered. (Addressed in Table 3, Item 6.)	C^+
7	Color coding for system status includes a blue code for emergency services. This color is not generally associated with alarm conditions (not a display stereotype).	Blue coding is no longer used.	C

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Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
8	Many actions submitted by the user were accepted by the system, but the action did not actually occur. For example, the user initiated a TCW restart, the system accepted and verified the command, but the TCW was not restarted.	No problems were detected. All actions submitted by the users were carried out.	C
9	During an alarm condition the user must go to the messages list and read through the TV Monitor list to determine which message is responsible. This list does not aid the user in identifying the source of the alarm.	The message display provides useful information. However, the display would be more informative with the addition of message color coding. Suggest moving acknowledged messages to a file rather than having them remain in the display. (Addressed in Appendix B, Table 2, Item 36.)	C^+
10	When a LAN is disconnected from a TCW, the TCW icon turns red, but it is impossible to identify which LAN failed.	When a LAN cable is disconnected, the affected equipment and LAN are easily identified from the main display.	C
11	No feedback is provided in response to some commands (e.g., when the OCP was restarted). Without feedback, the user may repeat an action that has already been performed.	Feedback is provided in response to all commands.	C
12	When starting the Startup OCP, the user must deselect MCP-1 or it will also restart the workstation in use.	This has been rectified.	C
13	The Magnetic Offset function provides no anchors on the slide bar. There is not a method to directly type in a value.	There is no longer a Magnetic Offset function. No slide bars are used for data input.	C
14	There are many abbreviations. This requires the user to memorize a lot of information to use the system.	Very few abbreviations remain and labels are spelled out whenever possible. Relevant service labels should be site adaptable.	C
15	Some terminology is not used consistently. For example, TCWs are referred to inconsistently - sometimes they are referred to as OCP and on other occasions they are called TCWs. To take a TCW off-line (or to put one back on-line) the user must choose a menu option, Exit OCP, from the Control Menu window.	Terminology has been made more consistent, but OCP is used ambiguously in some feedback message windows (e.g., OCP represents the MCW OCP and AT OCP).	R
16	There is no blinking or flashing. For example, when the ESL subsystem is minimized and when a critical event arises, the color of the ESL icon changes but does not blink.	Flashing is now used in the ESL window, but the minimized window icon does not flash in response to changes in status. It should flash until acknowledged.	R

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Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
17	The object selection process is too cumbersome and induces errors. Too many steps are required to get status information. To get status information about a particular OCP, the user must first left click on the OCP icon (a right click will display a non-functional pop-up menu), then the user must right click on the icon again to get a pop-up menu from which a status option can be chosen. Error Example: It is possible to select a button with the left mouse button, point to a different button, click with the right mouse button and get the original button's menu. This could be confusing.	Right clicking has been eliminated. Most actions can be carried out very quickly and easily, requiring no more than two clicks.	C
18	The Select a Drive option can be accessed anywhere within the window and it doesn't do anything.	The Select a Drive option has been eliminated.	C
19	Passwords can be turned off, which means users can change password without knowing the old password. (This option can be disabled.)	There is a need to review and implement ESL subsystem security and time-out.	R
20	SUN VTS software is in separate directories (UNIX level). VTS diagnostics are run from the UNIX console window.	Diagnostics are now accessed via a GUI. (Addressed in Table 3, Item 3.)	C^+
21	When services are disabled, buttons in the sub-menus disappear. This may prove to be disorienting for the operator.	Buttons disappearing may be preferable to buttons being grayed out but should be reviewed. Reconfiguration of the window, depending on the data available, may be disorienting. The colored indicators in the status windows look too much like accessible buttons. There is not enough contrast between these two items. Consider changing the indicators, possibly through shape or color coding, to make them look less like buttons.	R

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Table 3. Status of Original MCW CHI Issues for Both Subsystems

Item No.	Comments from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
1	Display formats are incompatible: • There are at least 4 different interactive styles between the two subsystems, which requires the user to learn each subsystem independently. Learning 4 different interactive styles could lead to inefficient operations and may result in error, especially when user is performing under high workload conditions. • Both subsystems allow the user to open a large number of windows at once; the user can easily lose the relationship between the open windows. • When multiple windows are opened, they obscure the previously opened windows because they are placed directly over them. • Color coding is inconsistent between the two subsystems.	The two subsystems are more compatible, but are very different. They should be better integrated. Consider providing a method to see the overall subsystem status (i.e., the FSL and ESL subsystems) from a single screen. Operator interactive functions should be consistent between the FSL and ESL subsystems. An integrated system should have the following qualities: 1) Identical coding strategies for alarms (color, etc.), 2) Identical access and execution of system commands, 3) Consistent data display formatting, 4) Consistent monitoring and reporting of resources, and 5) Intuitive graphical representation of the overall system which maps to the user's mental representation of the system.	R
2	There is not a consistent method for switching between the ESL and FSL subsystems. Currently, the user must minimize the ESL subsystem window to return to the FSL subsystem.	Switching between the FSL and ESL subsystems is cumbersome. Further work should be undertaken to integrate the two subsystems. (Addressed in Item 1.)	R
3	The diagnostic routine was begun and completed, but the user was only provided with pass/fail information. The user was unable to view specific test values.	In most cases, pass/fail information is sufficient. On occasion, more specific information is needed. The SUN VTS GUI that was reviewed needs improvements in formatting (e.g., contrast). Other Sun VTS options may provide this information and should be considered. The SUN VTS interface is different for the FSL and ESL subsystems and should be made consistent.	R
4	When shutting down a TCW, the user is not required to confirm the request.	This has been rectified.	C
5	The user must use a command window (UNIX command-line interface) to perform any diagnostics. The actual diagnostic command is different on each system. The user must type the correct name of the TCW in the command window. The TCW names are not the same in both subsystems.	It is no longer necessary to type a UNIX command to run diagnostics.	C

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Item No.	Comments from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
6	Visual and audible alarms are not consistent. Color coding, flashing, and audible alarms are used in the FSL subsystem, only visual (steady color) coding in the ESL subsystem.	Equipment status color codes, blinking, and alarms should be consistent between the FSL and ESL subsystems. Utilization of color, flashing, and audible alarms should be standardized. Red, yellow, green, and gray colors should have the same meaning on both subsystems and be consistent with other AF systems and accepted HF practices. For example, currently, blinking on the ESL subsystem is red/black and on the FSL subsystem, it is red/green. Redundant coding (i.e., coding in addition to color coding) should also be provided.	R
7	The method for changing the subsystem status is not the consistent. For the ESL subsystem, the user goes to the Control Menu (a window) and chooses exit OCP, then selects TCW/OCP to be taken off-line. In the FSL subsystem, user clicks on the TCW icon and a Pop-Up Menu appears, from which the user must select Reconfigure, then select Off-Line.	The interaction styles of the FSL and ESL CHIs are different. The two subsystems should follow a similar logic in how functions are carried out, how many windows are required, and the progression between windows. Emphasis should be on simple, efficient interactions (e.g., minimized steps for all data entry and control actions). (Addressed in Item 1.)	R
8	Automatic log-off was not observed after a period of inactivity.	The ESL subsystem has an adaptable log out, but the FSL subsystem does not. Users should receive a warning message before being logged out. Security for both subsystems is inconsistent and should be evaluated.	R
9	Too many windows can be open at any one time and they open on top of each other. This can be very disorienting to a user. It is hard to determine which windows or applications were open. No parent-child relationship to windows.	Windows open on top of each other. Window presentation strategy should be reviewed and modified.	R
10	Many of the functions in both subsystems require a UNIX command window. UNIX command-line language does not accept upper and lower case as equivalent.	Use of UNIX has been minimized, however, UNIX training should be provided to users.	R
11	When a user resizes windows, text wraps in ESL subsystem windows but not in FSL subsystem windows.	The two subsystems are not consistent in the way windows are sized. A review should be made of all windows to identify window resizing requirements.	R
12	There is a lack of consistent labels. For example, in the FSL subsystem, labels on working positions change based on assigned airspace (e.g., DR/D6 instead of TCW1). This requires MCW operators to perform mental operations to identify workstations and may be particularly bothersome when switching from the FSL to ESL subsystem. (The ESL subsystem always uses a TCW number.)	Labels are consistent between subsystems and do not change according to assigned airspace.	C

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Item No.	Comments from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
13	There is no simple way for the user to determine the relationship between items on the MCW displays and the operating positions on the floor. The TCW buttons on the main display are not mapped to floor locations of the workstations, and some of the positions presented don't exist.	Nonexistent positions have been removed. TCW icons can be arranged by the users to represent positions on the floor. There are some limitations when the number of TCWs is large. (Addressed in Item 1.)	C^+
14	Modification of mouse control parameters is not readily accessible to the user (cursor movement speed, double-click speed, adaptation to left or right-handed operators).	Cursor speed is adaptable on both subsystems. There should be an ability to adjust the mouse click speed and to adapt to left- or right-handed operators.	R
15	System message window displays are dense and difficult to read, for example, the TV Monitor [i.e., notifications] window.	Contrast between text color and background is better in the ESL subsystem. Some convention should be established and followed by both subsystems to optimize text presentation in message windows. Consider providing a limited range of user selectable font sizes.	R
16	For the ESL subsystem, there is an indication of an option menu available for data field entry. However, in the FSL subsystem, option menu fields look exactly the same as manual data entry fields.	The presentation of option menu and data entry fields has been improved, but the two subsystems are not consistent on how data fields are represented. Data entry format should be consistent between the two subsystems. Guidance for data entry field format should be clear and follow accepted format conventions.	R
17	A UNIX window must be used to change the time on the ESL subsystem versus a simple procedure for the FSL subsystem.	Time can be easily set on both subsystems, however, there is no consistent method. (Addressed in Item 1.)	C^+
18	There is no easy way to change the font sizes in windows. The font size in the pull-down menus are too small and are a different size than the pop-up menus available when buttons are selected. Different fonts are used in the different CHI modes.	Font size, color, and contrast need to be re-evaluated. In most windows, font size is too small. The gray color for unavailable commands may not be dark enough. Both subsystems should use the same color/font/size convention. Make font size user configurable.	R
19	In both subsystems, when the cursor was placed over an object for a period of time, feedback was not provided to indicate which object would be selected.	Objects are highlighted in both subsystems whenever the cursor is placed over the object. However, the color of highlighting should be reviewed for consistency between the two subsystems. (Addressed in Item 1.)	C^+
20	Users are not notified that they do not have sufficient access privileges to invoke a command until they have entered a new value and attempted to submit it to the system. For example, when the user attempted to modify a library in the FSL subsystem, it allowed new data to be entered in the data entry field, and the apply button to be selected, before the user was notified about not having write permission.	The current implementation of access notification is acceptable.	C
21	Neither subsystem provides the capability for all complete commands to be performed from a single input device. Modifying many of the parameter values required selection and entry using both the keyboard and mouse.	Quick keys are not enabled and improvements in the flexibility between input devices are required. Consider the use of function keys to perform functions that require multiple key strokes or mouse actions. Use of the keyboard should be an option in case the mouse fails.	R

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Item No.	Comments from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	User Status*
22	Some menu options needed ellipses […], which indicate that another window will appear when that option is chosen.	Ellipses are provided when appropriate on all menu options.	C
23	The frequency, modulation, and duration of auditory alarms is not adaptable.	There are no audible alarms in either subsystem, however, they should be provided. There should be a review to determine what alarm options should be user or site adaptable. There should always be a redundant visual alert with any auditory alarm.	R

* C = Closed; R = Remaining; C^+ = The original item is closed, but a more general issue remains to be addressed.

Appendix B

Open MCW CHI Issues

Table 1. Open FSL Subsystem MCW CHI Issues

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
1	There are at least 17 different codes (consisting of combinations of color, blinking, and location) used on the main page of the FSL subsystem. There are 12 colors used (page 18 of manual). There are also at least three further color codes for lettering in windows. There are also two window boundary color codes to indicate if the user has control over the window. There is color coding in data entry fields to indicate whether entry is allowed, not allowed, or incorrect. Some of the color contrast (letters on buttons) may not be sufficient (e.g., yellow on green for TCW failure). This is too many codes for the operator to learn and use and could lead to confusion and errors.	The coding of the FSL subsystem is greatly improved. However, a review of the color assignments is needed to ensure that they conform to colors used in other AF systems. Redundant coding is needed. Other issues include: • Some failures may be color coded incorrectly as catastrophic. • The iconified main window should only flash when there are unacknowledged high priority or catastrophic messages. • Lower level failures are not necessarily propagated to the higher level display. • Acknowledging faults returns items to light green (indicating normal operating status) even though the system may be operating in degraded mode. • The indication of which tape is being used for CDR and which are in standby is not clear or consistent with the other color schemes. • In the diagnostic reports, failed tests should be color coded to indicate a failed status. Colors should be consistent with system color coding schemes. • The color coding scheme should follow the failure for all applicable views. • There are several different configurations (available, available/testing, available/playback, off-line, off-line/testing, and maintenance) that should be reviewed and simplified.	Color selection (8.2.4.1) Color coding (8.5.4.5)
2	There are three types of user interfaces in the FSL subsystem: a point-and-click, pull-down menu, and button interface; a simpler key-controlled interface; and a UNIX command window. This requires the user to learn too many interaction styles and is not consistent. The UNIX windows in particular require very complex command syntax. Example: To launch diagnostic tests, users must enter several commands using UNIX command language, which requires extensive training (1472D, Table XXVIII). Once the diagnostic program is launched, the user must switch from using UNIX command language and begin using tabs and the space bar to navigate menus.	There is a reduced reliance on the UNIX interface. The system should have a GUI-type of CHI for the SUN VTS diagnostics, instead of the keyboard-controlled interface. (Addressed in Item 23.)	Consistent control actions (8.1.1.1)

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
3	The settings for the audible alarm range from 0 to 255. The units are arbitrary. The alarm volume can be turned to zero volume, which means the user may not be notified of an emergency.	Auditory alarms are not available. Auditory alarms are needed.	Alarms (6.12.1) Auditory coding (8.5.4.3)
4	There is no indication of processing status. For example, several minutes may be required for some diagnostic routines. There is no indication of how much time has elapsed. There may also be no indication that the system is in a diagnostic mode. When analysis is being conducted, there is no feedback to notify the user that analysis has been completed.	In the SUN VTS window, there is an elapsed time indicator that updates every 5 seconds. There is no indication that diagnostics have commenced for a few seconds. This could suggest to the user that nothing is occurring. A "testing completed" message appears when the tests are finished. In general, there should be 1) an indication that the system is in test mode, 2) an indication that the test is progressing, and 3) an indication of how much time is remaining.	Feedback (8.1.3.2)
5	Alarm message acknowledgment is awkward. Messages can be acknowledged all at once, page-by-page from the Messages window, or one at a time in message box (main display). When the user acknowledges all alarms, it could result in confusion over which message produced the alarm. The user must open the messages list and read through the messages to determine which is responsible. This list does not aid the user in identifying the source of the alarm. From the main monitoring window, users can only view one message at a time. This message must be acknowledged in order to move to the next message. Users may be forced to acknowledge several less important alarms (without being able to take action) in order to reach a critical alarm. It is likely that important information could be inadvertently lost.	Catastrophic messages should appear at the top of the list, in the message window at the top of the screen. Color coding of alphanumeric messages should be considered. Column headers for alarm messages should also be considered. Error message text should be clear, unambiguous, and consistent with the ESL subsystem. In general, alarm message display and handling needs to be evaluated and revised.	Alert and alarm characteristics (5.7.10) Presentation of status and diagnostic information (5.7.9)
6	There is no on-line help system available.	On-line help is not available. AF systems specialists should be asked to identify what information needs to be provided on-line.	Help windows (8.3.12.1)
7	The color of Radar Link button did not change to red even though there was a critical failure. Removing a single FSL subsystem LAN connection was not detected by the MCW. Removing both FSL subsystem LAN connections changed the color of the icon to flashing red and light green. Thus, it is possible to lose critical resources without an indication on the MCW.	There are problems with the alarm indicators when there is a system failure. For example, when LAN A was disabled, the system showed a failure of both LAN A and B. Also, the CGW A icon goes gray, but there are too many incorrect alerts for this one LAN failure. System error detection requires more analysis.	Alarms (6.12.1) Color coding (8.5.4.5)
8	Audible alarms do not discriminate between alarm conditions. The same auditory alarm is used for all types of alarms and for other informational messages.	Auditory alarms are not available. Auditory alarms are needed.	Auditory coding (8.5.4.3) Alarms (6.12.1)
9	Some actions do not provide feedback when the user reconfigures a screen.	This is partially complete. A confirmation is needed for MSAW. The CHI should be re-evaluated to determine whether sufficient error feedback is provided in all cases.	Feedback (8.1.3.2)

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
10	The lines below the Radar Link buttons (in Radar Link window), which indicate status of incoming radar links, are not labeled. When viewing the status of a radar link, the meaning of the two vertical lines is not apparent.	Labels have been added, but it is recommended that labels and color coding be evaluated in more detail. The Radar Link window is small, but has a large colored button. This button may not give much information via its color coding. The legs are not visible when colored gray. The Radar Link window formatting and functionality should be reviewed.	Color coding (8.5.4.5)
11	To place a TCW in the test state, assigned airspace must be moved to another station; the TCW must be placed in off-line maintenance mode; and a UNIX window opened and the testing software launched. This procedure involves multiple steps and does not provide guidance. For example, if the user attempts to take the TCW off-line before reassigning airspace, the Off-Line Maintenance option is dimmed, but no indication is provided as to how to remove the workstation for maintenance.	It is no longer necessary to open a UNIX window to take a TCW off-line. Some FSL functions require multiple steps, for example bringing TCWs and radar links on-line. To bring a TCW from maintenance to on-line, it must first be taken off-line. It would be preferable to go directly from maintenance to on-line, or from on-line to maintenance. In general, there should be three system states (i.e., on-line, standby, and off-line). To bring radar links on-line, the user must bring the radar link on-line, select VSP and then enable three separate weather items. There is no indication that these must be enabled. The user must go to a long list to find the items to be enabled, and the process requires multiple steps.	Minimal user action (8.1.1.7)
12	System VSP Control contains a long scrolling list that appears to include functions not required by an MCW operator.	The system VSP Control window contains functions that may not be required by an MCW operator and should be reviewed (e.g., functions such as Flight Plan Miscellaneous Parameters and ATIS code may not be needed).	Usable, essential data for a transaction (8.5.1.6)
13	Window Titles • Windows have two titles. One on the top border, and one inside the window. • Some windows have two titles which are not the same. • Not all window titles are in Title Case. Some words in a title start with lower case letters.	Different titles are acceptable, but the font size for title bars in windows should be larger. Titles should be reviewed for their relationship to the window contents.	Menus and menu selection (8.1.11) Text in windows (8.3.10.4)
14	There is no way to distinguish between manual data entry boxes and those with a drop-down menu. The Pop-Up Menu and manual entry provide no indication which type of entry is required. Without distinguishing features, the operator may not be able to tell which type of data entry is permitted, leading to unnecessary actions and errors.	There are some data entry fields that have pop-up menus with no indication of this capability.	Data Entry (8.4)
15	Response message areas are sometimes unnecessarily large. Response messages are sometimes in mixed case, sometimes upper case. This could be understood to indicate different types of messages.	The response message area remains large, but this is not a problem. Response message case is used inconsistently and should be standardized to mixed case.	Upper vs. mixed case text (10.3.3.6)

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
16	The system beeps when a out-of-range value is entered (sometimes). Sometimes, when an ineligible entry was given (e.g., c when only a or b were options), the system would beep after Modify was clicked or the Enter key was pressed. There appeared to be some inconsistency to the range checking /feedback process.	When characters are entered beyond the space available in the box, beeping occurs with every key press. If an out-of-range value is entered, the entry field becomes red after OK is clicked. The entry location should only have enough room for the maximum characters being input. Consider keying text entry fields to data entry format, for example - - / - - / - - (for day, month, and year).	Text (8.4.2)
17	It may be possible for a specialist to log in at a supervisory level and be vulnerable to having someone else log in at a lower level, thus revoking the earlier log-in. This might prove confusing if several people are using the system concurrently. Some commands seem to be available even though they cannot be accessed at the current log-in level. This might lead to confusion regarding system operation.	Passwords are required and provide access only to approved functionality. Too many levels of system authorization are used, therefore, consider using fewer levels. Access to MSAW tiles should be evaluated.	System security (11)
18	One of the main commands, Authorization, has no sub-menus and is not consistent with the others.	Authorization is not consistent with other main commands. Consider making Access Levels pull down menu to simplify the interaction. Consider moving the Print command under another menu option.	Menu and menu selection (8.1.11)
19	Tabular data displays: • Tables do not have consistent text justification. Some columns are left-justified, some are right-justified, and some are centered (e.g., RTQC Registration Control Report window). • Some columns are not evenly spaced (e.g., System VSP Control window). • Some column headings are crowded together, such as 1/512NM.	Tabular lists are inconsistently formatted and should be reviewed.	Formatting (10.4.5.4)
20	Labeling: • Missing labels. Some groups and items are missing labels. For example, the data recorders and LAN lines. • Label location. Labels are not located in a consistent manner. Not all labels are unique. The primary and redundant RDAs (A or B) and Local MCW (1 or 2) systems are identically labeled and the user must look to the button to determine which system it represents.	Labeling is improved, however, consider changing CDR A/B to CDR 1/2 and, likewise, with RDP and CGW.	Labeling and marking information (8.5.6.6)

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
21	Display formats are incompatible: • There are at least 4 different interactive styles between the two subsystems, which requires the user to learn each subsystem independently. Learning 4 different interactive styles could lead to inefficient operations and may result in error, especially when user is performing under high workload conditions. • Both subsystems allow the user to open a large number of windows at once; the user can easily lose the relationship between the open windows. • When multiple windows are opened, they obscure the previously opened windows because they are placed directly over them. • Color coding is inconsistent between the two subsystems.	The two subsystems are more compatible, but are very different. They should be better integrated. Consider providing a method to see the overall subsystem status (i.e., the FSL and ESL subsystems) from a single screen. Operator interactive functions should be consistent between the FSL and ESL subsystems. An integrated system should have the following qualities: 1) Identical coding strategies for alarms (color, etc.), 2) Identical access and execution of system commands, 3) Consistent data display formatting, 4) Consistent monitoring and reporting of resources, and 5) Intuitive graphical representation of the overall system which maps to the user's mental representation of the system.	Consistency (5.1.1) General (8.1.1) Display Integration (5.2.19)
22	There is not a consistent way to switch from the ESL to FSL subsystem. Currently, the user must minimize the ESL window to return to the FSL subsystem.	Switching between the FSL and ESL subsystems is cumbersome. Further work should be undertaken to integrate the two subsystems. (Addressed in Item 21.)	Consistency (5.1.1) Minimal user actions (8.1.1.7)
23	The diagnostic routine was begun and completed, but the user was only provided with pass/fail information. The user was unable to view specific test values.	In most cases, pass/fail information is sufficient. On occasion, more specific information is needed. The SUN VTS GUI that was reviewed needs improvements in formatting (e.g., contrast). Other Sun VTS options may provide this information and should be considered. The SUN VTS interface is different for the FSL and ESL subsystems and should be made consistent.	Consistency (5.1.1) Accessibility of status information (5.7.4)
24	Visual and audible alarms are not consistent. Color coding, flashing, and audible alarms are used in the FSL subsystem, only visual (steady color) coding in the ESL subsystem.	Equipment status color codes, blinking, and alarms should be consistent between the FSL and ESL subsystems. Utilization of color, flashing, and audible alarms should be standardized. Red, yellow, green, and gray colors should have the same meaning on both subsystems and be consistent with other AF systems and accepted HF practices. For example, currently, blinking on the ESL subsystem is red/black and on the FSL subsystem, it is red/green. Redundant coding (i.e., coding in addition to color coding) should also be provided.	Alarms (6.12.1) Color coding (8.5.4.5)
25	The method for changing the subsystem status is not the consistent. For the ESL subsystem, the user goes to the Control Menu (a window) and chooses exit OCP, then selects TCW/OCP to be taken off-line. In the FSL subsystem, user clicks on the TCW icon and a Pop-Up Menu appears, from which the user must select Reconfigure, then select Off-Line.	The interaction styles of the FSL and ESL CHIs are different. The two subsystems should follow a similar logic in how functions are carried out, how many windows are required, and the progression between windows. Emphasis should be on simple, efficient interactions (e.g., minimized steps for all data entry and control actions). (Addressed in Item 21.)	Consistency (5.1.1) General (8.1.1)

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
26	Automatic log-off was not observed after a period of inactivity.	The ESL subsystem has an adaptable log out, but the FSL subsystem does not. Users should receive a warning message before being logged out. Security for both subsystems is inconsistent and needs to be evaluated.	System security (11)
27	Too many windows can be open at any one time and they open on top of each other. This can be very disorienting to a user. It is hard to determine which windows or applications were open. No parent-child relationship to windows.	Windows open on top of each other. Window presentation strategy should be reviewed and modified.	Window management considerations (8.3.11)
28	Many of the functions in both subsystems require a UNIX command window. UNIX command-line language does not accept upper and lower case as equivalent.	Use of UNIX has been minimized, however, UNIX training should be provided to users.	Selection of interaction type (8.1.8.1) Deliberate changes in human roles, functions, and tasks (5.4.2)
29	When a user resizes windows, text wraps in ESL subsystem windows but not in FSL subsystem windows.	The two subsystems are not consistent in the way windows are sized. A review should be made to identify window resizing requirements.	Window management considerations (8.3.11)
30	Modification of mouse control parameters is not readily accessible to the user (cursor movement speed, double-click speed, adaptation to left- or right-handed operators).	Cursor speed is adaptable on both subsystems. There should be an ability to adjust the mouse click speed and to adapt to left- or right-handed operators.	Mouse (8.8.3.2)
31	System message window displays are dense and difficult to read, for example, the TV Monitor [i.e., Notifications] window.	Contrast between text color and background is better in the ESL subsystem. Some convention should be established and followed by both subsystems to optimize text presentation in message windows. Consider providing a limited range of user selectable font sizes.	Text in windows (8.3.10.4)
32	For the ESL subsystem, there is an indication of an option menu available for data field entry. However, in the FSL subsystem, option menu fields look exactly the same as manual data entry fields.	The presentation of option menu and data entry fields has been improved, but the two subsystems are not consistent on how data fields are represented. Data entry format should be consistent between the two subsystems. Guidance for data entry field format should be clear and follow accepted format conventions.	Data entry (8.4)
33	There is no easy way to change the font sizes in windows. The font size in the pull-down menus are too small and are a different size than the pop-up menus available when buttons are selected. Different fonts are used in the different CHI modes.	Font size, color, and contrast need to be re-evaluated. In most windows, font size is too small. The gray color for unavailable commands may not be dark enough. Both subsystems should use the same color/font/size convention. Make font size user configurable.	Color coding (8.5.4.5) Text in windows (8.3.10.4)
34	Neither subsystem provides the capability for all complete commands to be performed from a single input device. Modifying many of the parameter values required selection and entry using both the keyboard and mouse.	Quick keys are not enabled and improvements in the flexibility between input devices are required. Consider the use of function keys to perform functions that require multiple key strokes or mouse actions. Use of the keyboard should be an option in case the mouse fails.	Interchangeability among input devices (8.8.5)

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
35	The frequency, modulation, and duration of auditory alarms is not adaptable.	There are no audible alarms in either subsystem, however, they should be provided. There should be a review to determine what alarm options should be user or site adaptable. There should always be a redundant visual alert with any auditory alarm.	Alarms (6.12.1) Auditory coding (8.5.4.3)
36	N/A (New item).	The FSL does not always accurately display system status (including normal and abnormal conditions). TCW #8 had frozen data tags and the message, Display Frozen - Select ESL Mode, was displayed, yet the MCW showed no errors. The color indicated good status. The external radar interface was removed, but there was no indication at the MCW as to what radar had failed. Also there were no targets at the TCW but the MCW presented the status as normal.	Status information (8.1.3.4)
37	N/A (New item).	After changing the frequency of the periodic background test, there is no indication as to when the change is to take effect. Having zero (0) time will shut off background tests and should not be an option. The range of background test periodicity should be reviewed with input from the vendor.	Feedback (8.1.3.2)
38	N/A (New item).	The SPC button provides aircraft emergency declarations and is not a maintenance function. If an aircraft is in emergency, maintenance should not be required to acknowledge it. The SPC code indicator and the need to acknowledge SPC codes should be removed from the MCW.	Usable, essential data for a transaction (8.5.1.6)
39	N/A (New item).	The system does not have sufficient functions to support system verification and certification. Verification and certification results are not readily available and may be inaccurate or incomplete.	Status information (8.1.3.4)
40	N/A (New item).	Feedback regarding diagnostic tests is inconsistent between subsystems. The ESL provides feedback on the percentage of tests that are completed, whereas the FSL does not. It would be beneficial to provide estimated completion times and percent of tests completed.	Feedback (8.1.3.2)
41	N/A (New item).	A consistent method should be developed to access diagnostics on multiple systems simultaneously.	Consistency (5.1.1)
42	N/A (New item).	A print function should be available to print all messages and reports to a printer or a file.	Incoming message operations (8.3.12.5.10)
43	N/A (New item).	Options available in UNIX to make the system more functional should be evaluated and enabled (e.g., backspace key, directory tree, and confirmation messages for destructive commands).	Confirmed destruction (8.1.1.27)
44	N/A (New item).	Consider color coding system messages for priority and moving acknowledged messages to a file.	Color coding (8.5.4.5)

Table 2. Open ESL Subsystem MCW CHI Issues

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
1	It is difficult for the operator to determine status details from the main display. Though radar failed, there was no indication at the top-level-monitoring screen since radar was coming from a second site (the workstation icon remained green). A user would have to drill down to system status to find out that data from one radar was missing. Furthermore, Radar Link status is not monitored.	For the sources that are being monitored, the error display is adequate. All failures are now indicated on the main display through the use of color and flashing. However, not all the ESL subsystem configured sources are being monitored.	Status information (8.1.3.4)
2	No audible alarms are used in the ESL subsystem. If a user is distracted from the display, there is no cue to call attention back to the screen.	The ESL subsystem does not provide audible alarms. It should have alarms for critical events and they should differ from other audible alarms.	Alarms (6.12.1) Alert and alarm characteristics (5.7.10) Auditory coding (8.5.4.3)
3	The system uses inconsistent user interface input methods. The ESL subsystem provides GUI, character-based menu, and UNIX interfaces. Main ESL controls are dispersed among three windows (control menu, TV monitor [i.e., notifications], and consoles).	Virtually all functions are performed via a GUI. The requirement for the use of UNIX has been reduced. Window management is cumbersome. The ESL subsystem consists of three unintegrated windows. This requires the user to take more actions to open, close, and manage (resize and locate) each of the windows.	Minimal user action (8.1.1.7) Menu bars (8.1.11.4)
4	Some terminology is not used consistently. For example, TCWs are referred to inconsistently - sometimes they are referred to as OCP and on other occasions they are called TCWs. To take a TCW off-line (or to put one back on-line) the user must choose a menu option, Exit OCP, from the Control Menu window.	Terminology has been made more consistent, but OCP is used ambiguously in some feedback message windows (e.g., OCP represents the MCW OCP and AT OCP).	Labeling and marking: General (7.5.1)
5	There is no blinking or flashing. For example, when the ESL subsystem is minimized and when a critical event arises, the color of the ESL icon changes but does not blink.	Flashing is now used in the ESL window, but the minimized window icon does not flash in response to changes in status. It should flash until acknowledged.	Alarms (6.12.1) Visual warning and signal devices (7.2.1.5)
6	Passwords can be turned off, which means users can change password without knowing the old password. (This option can be disabled.)	There is a need to review and implement ESL subsystem security and time-out.	System security (11)
7	When services are disabled, buttons in the sub-menus disappear. This may prove to be disorienting for the operator.	Buttons disappearing may be preferable to buttons being grayed out but should be reviewed. Reconfiguration of the window depending on the data available may be disorienting. The colored indicators in the status windows look too much like accessible buttons. There is not enough contrast between these two items. Consider changing the indicators, possibly through shape or color coding, to make them look less like buttons.	Presentation of status and diagnostic information (5.7.9)

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
8	Display formats are incompatible: • There are at least 4 different interactive styles between the two subsystems, which requires the user to learn each subsystem independently. Learning 4 different interactive styles could lead to inefficient operations and may result in error, especially when user is performing under high workload conditions. • Both subsystems allow the user to open a large number of windows at once; the user can easily lose the relationship between the open windows. • When multiple windows are opened, they obscure the previously opened windows because they are placed directly over them. • Color coding is inconsistent between the two subsystems.	The two subsystems are more compatible, but are very different. They should be better integrated. Consider providing a method to see the overall subsystem status (i.e., the FSL and ESL subsystems) from a single screen. Operator interactive functions should be consistent between the FSL and ESL subsystems. An integrated system should have the following qualities: 1) Identical coding strategies for alarms (color, etc.), 2) Identical access and execution of system commands, 3) Consistent data display formatting, 4) Consistent monitoring and reporting of resources, and 5) Intuitive graphical representation of the overall system which maps to the user's mental representation of the system.	Consistency (5.1.1) General (8.1.1) Display Integration (5.2.19)
9	There is not a consistent method for switching between the ESL and FSL subsystems. Currently, the user must minimize the ESL subsystem window to return to the FSL subsystem.	Switching between the FSL and ESL subsystems is cumbersome. Further work should be undertaken to integrate the two subsystems. (Addressed in Item 8.)	Consistency (5.1.1) Minimal user actions (8.1.1.7)
10	The diagnostic routine was begun and completed, but the user was only provided with pass/fail information. The user was unable to view specific test values.	In most cases, pass/fail information is sufficient. On occasion, more specific information is needed. The SUN VTS GUI that was reviewed needs improvements in formatting (e.g., contrast). Other Sun VTS options may provide this information and should be considered. The SUN VTS interface is different for the FSL and ESL subsystems and should be made consistent.	Consistency (5.1.1) Accessibility of status information (5.7.4)
11	Visual and audible alarms are not consistent. Color coding, flashing, and audible alarms are used in the FSL subsystem, only visual (steady color) coding in the ESL subsystem.	Equipment status color codes, blinking, and alarms should be consistent between the FSL and ESL subsystems. Utilization of color, flashing, and audible alarms should be standardized. Red, yellow, green, and gray colors should have the same meaning on both subsystems and be consistent with other AF systems and accepted HF practices. For example, currently, blinking on the ESL subsystem is red/black and on the FSL subsystem, it is red/green. Redundant coding (i.e., coding in addition to color coding) should also be provided.	Alarms (6.12.1) Color coding (8.5.4.5)
12	The method for changing the subsystem status is not the consistent. For the ESL subsystem, the user goes to the Control Menu (a window) and chooses exit OCP, then selects TCW/OCP to be taken off-line. In the FSL subsystem, user clicks on the TCW icon and a Pop-Up Menu appears, from which the user must select Reconfigure, then select Off-Line.	The interaction styles of the FSL and ESL CHIs are different. The two subsystems should follow a similar logic in how functions are carried out, how many windows are required, and the progression between windows. Emphasis should be on simple, efficient interactions, for example minimized steps for all data entry and control actions. (Addressed in Item 8.)	Consistency (5.1.1)

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
13	Automatic log-off was not observed after a period of inactivity.	The ESL subsystem has an adaptable log out, but the FSL subsystem does not. Users should receive a warning message before being logged out. Security for both subsystems is inconsistent and needs to be evaluated.	System security (11)
14	Too many windows can be open at any one time and they open on top of each other. This can be very disorienting to a user. It is hard to determine which windows or applications were open. No parent-child relationship to windows.	Windows open on top of each other. Window presentation strategy should be reviewed and modified.	Window management considerations (8.3.11)
15	Many of the functions in both subsystems require a UNIX command window. UNIX command-line language does not accept upper and lower case as equivalent.	Use of UNIX has been minimized, however, UNIX training should be provided to users.	Selection of interaction type (8.1.8.1) Deliberate changes in human roles, functions, and tasks (5.4.2)
16	When a user resizes windows, text wraps in ESL subsystem windows but not in FSL subsystem windows.	The two subsystems are not consistent in the way windows are sized. A review should be made of all windows to identify window resizing requirements.	Window management considerations (8.3.11)
17	Modification of mouse control parameters is not readily accessible to the user (cursor movement speed, double-click speed, adaptation to left- or right-handed operators).	Cursor speed is adaptable on both subsystems. There should be an ability to adjust the mouse click speed and to adapt to left- or right-handed operators.	Mouse (8.8.3.2)
18	System message window displays are dense and difficult to read, for example, the TV Monitor [i.e., Notifications] window.	Contrast between text color and background is better in the ESL subsystem. Some convention should be established and followed by both subsystems to optimize text presentation in message windows. Consider providing a limited range of user selectable font sizes.	Text in windows (8.3.10.4)
19	For the ESL subsystem, there is an indication of an option menu available for data field entry. However, in the FSL subsystem, option menu fields look exactly the same as manual data entry fields.	The presentation of option menu and data entry fields has been improved, but the two subsystems are not consistent on how data fields are represented. Data entry format should be consistent between the two subsystems. Guidance for data entry field format should be clear and follow accepted format conventions.	Data entry (8.4)
20	There is no easy way to change the font sizes in windows. The font size in the pull-down menus are too small and are a different size than the pop-up menus available when buttons are selected. Different fonts are used in the different CHI modes.	Font size, color, and contrast need to be re-evaluated. In most windows, font size is too small. The gray color for unavailable commands may not be dark enough. Both subsystems should use the same color/font/size convention. Make font size user configurable.	Color coding (8.5.4.5) Text in windows (8.3.10.4)
21	Neither subsystem provides the capability for all complete commands to be performed from a single input device. Modifying many of the parameter values required selection and entry using both the keyboard and mouse.	Quick keys are not enabled and improvements in the flexibility between input devices are required. Consider the use of function keys to perform functions that require multiple key strokes or mouse actions. Use of the keyboard should be an option in case the mouse fails.	Interchangeability among input devices (8.8.5)

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
22	The frequency, modulation, and duration of auditory alarms is not adaptable.	There are no audible alarms in either subsystem, however, they should be provided. There should be a review to determine what alarm options should be user or site adaptable. There should be a redundant visual alert with any auditory alarm.	Alarms (6.12.1) Auditory coding (8.5.4.3)
23	N/A (New item).	The window for enabling/disabling auto start uses reverse video to represent status. There is a need to clarify which code means enabled and which means disabled.	Color and shading (10.3.3.9)
24	N/A (New item).	The distinction between selected and non-selected buttons is unclear.	Graphical controls (8.1.15)
25	N/A (New item).	On-line diagnostic tests can only be run one at a time and prevent access to all other system functions. An efficient method of running diagnostics simultaneously on multiple pieces of equipment is needed.	Maintenance and operations interference (9.1.5)
26	N/A (New item).	Entering system time is cumbersome with the GUI buttons. Entry fields should be provided to permit keyboard entry.	Interchangeability among input devices (8.8.5)
27	N/A (New item).	The text in the Primary Channel Group Status window only lists the channel number. Consider adding the name of the radar interface associated with the channel number.	Labeling and marking information (8.5.6.6)
28	N/A (New item).	There are two actions required to close windows, clicking on File and selecting Close. Consider simplifying the method of closing windows to one action.	Minimal user actions (8.1.1.7)
29	N/A (New item).	When using SUN VTS, the output is black text on a white background. This is not consistent with other data displays.	Consistency (5.1.1)
30	N/A (New item).	AF functionality should be moved from the TCW AT CHI to the MCW. When this functionality is moved, it should be reviewed for usability.	Usable, essential data for a transaction (8.5.1.6)
31	N/A (New item).	The system does not have sufficient functions to support system verification and certification. Verification and certification results are not readily available and may be inaccurate or incomplete.	Status information (8.1.3.4)
32	N/A (New item).	Feedback regarding diagnostic tests is inconsistent between subsystems. The ESL provides feedback on the percentage of tests that are completed, whereas the FSL does not. It would be beneficial to provide estimated completion times and percent of tests completed.	Feedback (8.1.3.2)
33	N/A (New item).	A consistent method should be developed to access diagnostics on multiple systems simultaneously.	Consistency (5.1.1)
34	N/A (New item).	A print function should be available to print all messages and reports to a printer or a file.	Incoming message operations (8.3.12.5.10)

Item No.	Comment from preliminary report (April 1997)	Comment for follow-up evaluation (January 1998)	HFDG Reference
35	N/A (New item).	Options available in UNIX to make the system more functional should be evaluated and enabled. For example, backspace key, use of directory trees, and confirmation messages for destructive commands.	Confirmed destruction (8.1.1.27)
36	N/A (New item).	Consider color coding system messages for priority and moving acknowledged messages to a file.	Color coding (8.5.4.5)

Table 3. Unavailable MCW Functionality

Item No.	Subsystem	Functionality
1	FSL	A single command is needed to get the TCW back on-line for a cold start. The user is unable to cold-start a TCW from the MCW GUI. A cold-start can only be accomplished by physically cycling the power at the TCW. It should be possible to cold start a TCW from the MCW.
2	FSL	Error messages received were not representative of the system fault that was induced.
3	Both	Ring around and reflected target suppression by range and azimuth needs to be accomplished.
4	Both	The entire STARS system should be synchronized to an independent time source.
5	Both	Consider adding the capability to control the terminal surveillance system from the MCP.
6	Both	CDR tapes have no protection against being overwritten. Consider using the ARTS ODC method of overwrite protection.
7	Both	System and Service Certification must include the inducement of faults and errors to verify the on-line performance of the system.
8	Both	All resources to the STARS system must be monitored, verified, and controlled from the MCW. This is inclusive of external interfaces.
9	Both	Simulated radar inputs must be injected into the STARS system at the point where surveillance data enters the system.
10	Both	Need to have the ability to perform system administration functions from the MCW.
11	Both	Operators need to be logged off after an adaptable period of data entry set inactivity.
12	Both	A continuous data recorder is required on both service levels.

Table 4. MCW Hardware Items

Item No.	Hardware Item
1	An ergonomic evaluation of AF systems specialists' tasks may be needed.
2	The procedure to remove the Sony monitor from the TCW console appears awkward and may present access problems and should be reviewed. The front shelves of displays are not readily removable (unlike current systems), the cart may be cumbersome and difficult to use, and moving the monitor requires several steps.
3	There may be a grounding issue with the removal access doors (front & rear). The mating surfaces were not grounded to bare metal (for good surface contact), but rather a hole was drilled with a hardware (screw & nut) penetrating the hole. It mated against the manufacturers painted surface. Additionally, at the end of the wire, a forked lug was used to make the connection-this type of lug could be pulled off easier than if an eyelet type lug was used.
4	Tools and training to maintain LAN cabling, both RJ-45 and optical cable should be provided.